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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/534,217	05/06/2005	Kannan Ramanathan	NREL 02-29	1000

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EXAMINER

DIAMOND, ALAN D

ART UNIT	PAPER NUMBER
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1753

DATE MAILED: 07/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/534,217	RAMANATHAN ET AL.	
	Examiner	Art Unit	
	Alan Diamond	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 and 14-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 14-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 06 May 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Comments

1. The amendments to the specification filed May 5, 2006 are improper and have not been entered. Thus, the same objections to the specification that were set forth in the Office action mailed April 13, 2006 are also set forth below in the instant Office action. Note that said amendments to the specification merely refer to page and line number of portions of text. 37 CFR 1.121 sets forth the requirements for amendments to the specification. Amendments to the specification, other than the claims, computer listings (§ 1.96) and sequence listings (§ 1.825), must be made by adding, deleting or replacing a paragraph, by replacing a section, or by a substitute specification, in the manner specified in 37 CFR 1.121. See 37 CFR 1.121(b)(1)-(5) for the manner of amending the specification. It is suggested that Applicant replace each entire paragraph of the specification which has the objected to subject matter. The last amendment of the specification was to replace an entire page 2. This type of amendment is improper because page 2 starts in the middle of a paragraph and ends in the middle of a paragraph. Applicant will have to replace the paragraph starting on page 1 at line 29, the paragraph starting on page 2 at line 6, the paragraph starting on page 2 at line 16, and the paragraph starting on page 2 at line 23, in order to accomplish the replacement of page 2.

2. The 35 USC 112, second paragraph, rejection of the claims has been overcome by Applicant's amendment or cancellation of the claims.

Specification

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3. The disclosure is objected to because of the following informalities:

In order to more clearly indicate Figures 6A through 6G in the brief description of the drawings, the term "FIG. 6 is a graph" at line 17 on page 4 should be changed to "FIGS. 6A through 6G are graphs". Then the term "shown in FIGS. 6A thru 6G" at line 18 on page 4 should be deleted.

Portions of the text on page 2 are blurred, perhaps due to photocopying. It is requested that all of the paragraphs on page 2 be resubmitted in an amendment to the specification.

On page 5, at line 22, and on page 7, at line 14, the term "dehydrate" should be changed to "dihydrate".

Appropriate correction is required.

Specification

4. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: The "by volume" recitation in claim 1 at line 9 lacks positive basis in the specification. It is suggested that page 6, line 15, of the specification be amended so as to recite this.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

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6. Claims 1-9 and 14-17 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claim 1, at lines 8-9, the use of the word "about" to modify the 50% by volume is not supported by the specification, as originally filed. The specification does supported 50% acetic acid (presumably by volume) (see page 6, line 15). The word "about" would open the 50% to interpretation, and such interpretation is not supported by the originally filed specification. The same applies to dependent claims 2-9 and 14-17. It is suggested that the word "about" be removed from line 8 of claim 1.

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1-9 and 14-17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, at line 8, the term "etching in" should be changed to "etching with" so as to clearly indicated what is happening. The same applies to dependent claims 2-9 and 14-17.

Claim 1 is indefinite because it is not clear where the ZnO at line 9 is located or when it was formed during the process. It is suggested that the term "and form a ZnO

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deposit" be inserted after "Zn" at line 8, and then change the term "ZnO" at line 9 to "the ZnO deposit". The same applies to dependent claims 2-9 and 14-17.

Claim Rejections - 35 USC § 102/103

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 18 and 19 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Ramanathan et al (WO 99/17377).

Ramanathan et al prepares a thin film solar cell comprising a first layer of p-type CIGS, i.e., $\text{Cu}(\text{InGa})\text{Se}_2$, an n-type second layer from zinc chloride (instant zinc compound) that can be deposited by CVD or sublimation using zinc chloride as a vapor source; and the resulting zinc, chloride, and any other reaction products are etched with hydrochloric acid then provided with sputter-deposited ZnO (see page 3, lines 17-29; page 4, lines 9-14; and page 5, line 16 through page 6, line 2). It is the Examiner's position that the solar cell prepared by Ramanathan et al is essentially the same as here claimed, even though Ramanathan et al uses hydrochloric acid, rather than acetic acid, as the etchant in its process. With respect to claim 19, it is the Examiner's position

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that Ramanathan et al's solar cell prepared using zinc chloride is essentially the same as the instant solar cell prepared using zinc acetate dihydrate after the etching. Since Ramanathan et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

In the event that any differences can be shown for the produce of the product-by-process claims 18 and 19, as opposed to the product taught by the reference Ramanathan et al, such differences would have been obvious to one of ordinary skill in the art as a routine modification of the product in the absence of a showing of unexpected results; see also In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

12. Claims 1-3, 5, 18, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanathan et al (WO 99/17377) in view of Wright et al (U.S. Patent 4,687,725) and Yagi et al (U.S. Patent 5,454,146).

With respect to claims 1-3 and 5, Ramanathan et al prepares a ZnO/CIGS solar cell without depositing a buffer layer and by Zn doping from a vapor phase, comprising: depositing the CIGS, i.e., Cu(InGa)Se₂ layer on a Mo back contact on a glass substrate, subjecting the CIGS layer to zinc chloride vapor to dope the CIGS layer; etching the deposited zinc, chloride, and any other reaction products with hydrochloric acid (HCl) so as to rule out the presence of any buffer layer; and then sputter depositing ZnO by well known procedure (see page 4, line 9 through page 6, line 2). It is the Examiner's position that ZnO is formed as one of the "other reaction products" and a skilled artisan would recognize this in view of the fact that the doping with zinc chloride vapor does not occur in an inert, non-oxidizing atmosphere. The ZnO formed during the doping would

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subsequently be removed by the HCl etching as one of said "other reaction products" to be removed.

With respect to claims 18 and 19, Ramanathan et al prepares a thin film solar cell comprising a first layer of p-type CIGS, i.e., $\text{Cu}(\text{InGa})\text{Se}_2$, an n-type second layer from zinc chloride (instant zinc compound) that can be deposited by CVD or sublimation using zinc chloride as a vapor source; and the resulting zinc, chloride, and any other reaction products are etched with hydrochloric acid then provided with sputter-deposited ZnO (see page 3, lines 17-29; page 4, lines 9-14; and page 5, line 16 through page 6, line 2). It is the Examiner's position that the solar cell prepared by Ramanathan et al is the same as here claimed, even though Ramanathan et al uses hydrochloric acid, rather than acetic acid as the etchant in its process. With respect to claim 19, it is the Examiner's position that Ramanathan et al's solar cell prepared using zinc chloride is the same as the instant solar cell prepared using zinc acetate dihydrate after the etching.

Ramanathan et al teaches the limitations of the instant claims, other than the difference which is discussed below.

With respect to claims 1-3 and 5, Ramanathan et al does not specifically teach heating its glass substrate to a temperature of 100 to 250°C before subjecting the CIGS layer to the zinc chloride vapor. However, zinc chloride vaporizes at 720°C. In order for the vaporized zinc chloride to condense onto the glass substrate, the substrate should be maintained at a temperature lower than said 720°C. A skilled artisan would have been motivated to use a temperature of, for example, 200°C so that the zinc chloride

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could diffuse into the CIGS film (see page 5, lines 22-24 of Ramanathan et al). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have set Ramanathan et al's glass substrate at a temperature of, for example, 200°C and then deposited the zinc chloride from vapor onto the substrate because zinc chloride vaporizes at 720°C, and thus, in order for the vaporized zinc chloride to condense onto the glass substrate, the substrate should be maintained at a temperature lower than said 720°C; and because a skilled artisan would have been motivated to use a glass substrate temperature of, for example, 200°C so that the zinc chloride could diffuse into the CIGS film.

Also with respect to claims 1-3 and 5, Ramanathan et al does not specifically teach using acetic acid in place of hydrochloric acid for its etching. Wright et al teaches the interchangeability of using hydrochloric acid and acetic acid for etching zinc (see col. 9, lines 52-53). Yagi et al teaches that aqueous acetic acid is used as an etching solution for ZnO (see col. 6, lines 32-33). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used acetic acid in place of hydrochloric acid for Ramanathan et al's etchant because the substitution of art recognized equivalents, as shown by Wright et al, would have been within the level of ordinary skill in the art. Furthermore, a skilled artisan would recognize that acetic acid could be used to etch the ZnO that is formed as a result of the doping since aqueous acetic acid is used as an etching solution for ZnO, as taught by Yagi et al. The determination of an appropriate concentration of acetic acid in water for the etching would have been within the level of ordinary skill in the art.

Response to Arguments

13. Applicant's arguments filed May 5, 2005 have been fully considered but they are not persuasive.

Applicant argues that Figure 1 shows current density versus voltage for CIGS thin films not subjected to an evaporant species of zinc acetate dehydrate and on which ZnO was sputter deposited to arrive at a conversion efficiency of only 1.8%, and that Figures 2, 3, 4, 6A-6G, 7A-7G, 8A-8F, and 9 show current density versus voltage for CIGS thin film subjected to an evaporant species of zinc acetate dehydrate followed by sputter depositing ZnO to provide conversion efficiency ranging from 4.45 to about 13.1%. However, this argument is not deemed to be persuasive because Figure 1 is not a fair representation of Ramanathan et al. Ramanathan et al subjects its CIGS film with zinc chloride and arrives at conversion efficiency of 13.5% (page 6, line 4), which is better than Applicant's conversion efficiency. Any comparison with Ramanathan et al would have to include such a treatment with zinc chloride. With respect to product claims 18 and 19, no patentable difference in the final product has been shown by etching using acetic acid as opposed to etching using the HCl taught by Ramanathan et al, or by using zinc acetate as the Zn compound as opposed to zinc chloride. Claim 18 is silent concerning zinc acetate dehydrate. Claim 19 recites zinc acetate dehydrate, but, just as chloride is removed during Ramanathan et al's etching, so will acetate be removed during the instant etching. The resulting layer in the device is the same or essentially the same, i.e., a Zn doped CIGS layer.

Applicant argues that Ramanathan et al lacks subjecting CuInGaSe₂ (CIGS) films to evaporant species of zinc acetate dehydrate to dope the surface region n-type.

However, this argument is not deemed to be persuasive because the only method claims that require said zinc acetate dehydrate, i.e., claims 4, 6-9, and 14-17, are not rejected over Ramanathan et al. Furthermore, as noted in the immediately preceding paragraph, and with respect to product claims 18 and 19, no patentable difference has been shown by using zinc acetate as the Zn compound as opposed to zinc chloride. Claim 18 is silent concerning zinc acetate dehydrate. Claim 19 recites zinc acetate dehydrate, but, just as chloride is removed during Ramanathan et al's etching, so will acetate be removed during the instant etching. The resulting layer in the device is the same or essentially the same, i.e., a Zn doped CIGS layer.

Applicant argues that Wright et al relates to non-related art. However, this argument is not deemed to be persuasive because Wright et al has been relied upon for showing what is very well known, i.e., the interchangeability of using hydrochloric acid and acetic acid for etching zinc. When one is performing etching, in particular, of zinc as taught by Ramanathan et al, the interchangeability of using hydrochloric acid and acetic acid for etching zinc would be common knowledge.

Allowable Subject Matter

14. Claims 4, 6-9, and 14-17 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 1st paragraph and 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Conclusion

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alan Diamond whose telephone number is 571-272-1338. The examiner can normally be reached on Monday through Friday, 5:30 a.m. to 2:00 p.m. ET.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

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published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Alan Diamond
Primary Examiner
Art Unit 1753

Alan Diamond
June 30, 2006

A handwritten signature in black ink, appearing to read 'Alan Diamond', with a stylized flourish at the end.